

What is claimed is:

1. A radio communication apparatus having an array antenna made up by a plurality of antenna elements and an inter-array signal compositing unit for compositing signals received at the antenna elements together, the radio communication apparatus comprising:

a first radio circuit section for conveying the signals received at the antenna elements to the inter-array signal compositing unit;

a second radio circuit section for conveying the received signals;

a first channel estimating unit for determining a channel estimation value of a signal conveyed through the first radio circuit section;

a second channel estimating unit for determining a channel estimation value of a signal conveyed through the second radio circuit section;

a power detecting unit for detecting a power from an output of the first channel estimating unit;

an operating unit for detecting an amplitude ratio and phase rotation amount from outputs of the first and second channel estimating units; and

a correction-value detecting unit for detecting a correction value for correcting an amplitude deviation and phase deviation occurring on the first and second radio

circuit sections, from outputs of the power detecting unit and operating unit.

2. A radio communication apparatus according to claim 1, wherein the first radio circuit section, the second radio circuit section, the power detecting unit and the operating unit are provided in plurality correspondingly to the antenna elements, and comprise a plurality of first correlators for detecting the signals conveyed through the plurality of first radio circuit sections as signals arrived in different timing and outputting the detected signals to the first channel estimating unit, a plurality of second correlators for detecting the signals conveyed through the plurality of second radio circuit sections as signals arrived in different timing and outputting the detected signals to the second channel estimating unit, a first adder for adding outputs of the plurality of power detecting units together, and a second adder for adding outputs of the plurality of operating units together, the correction-value detecting unit detecting a correction value from outputs of the first and second adders.

3. A radio communication apparatus according to claim 2, further comprising a first selector unit for selecting one out of signals outputted from the plurality of first radio circuit sections, a plurality of power distributing units for distributing a power from the antenna elements of

the array antenna, a second selector unit for selecting one out of signals outputted from the plurality of power distributing unit and outputting a selected signal to the second radio circuit section, and a selector control unit for selecting, with control, the signal received at the same antenna element from signals outputted from the first and second selector units.

4. A radio communication apparatus according to claim 3, wherein the selector control unit makes control on the first and second selector units in a manner of selecting signals in one of a predetermined order, a desired order, a predetermined time interval and a desired time interval.

5. A radio communication apparatus according to claim 3, further comprising a correction-value memory unit for storing correction-value outputted from the correction-value detecting unit, separately for the antenna elements selected by the first selector unit and second selector unit, the inter-array signal compositing unit making an inter-array signal compositing process by using the correction values respectively for the antenna elements.

6. A radio communication apparatus according to claim 2, further comprising a first averaging-in-time unit for taking an average in time of output signals of one of the power detecting unit and the first adder, and a second averaging-in-time unit for taking an average in time of

output signals of one of the operating unit and the second adder, the first and second averaging-in-time unit storing a plurality of signals outputted from the adder in one process thereby making an averaging process in time.

7. A radio communication apparatus according to claim 2, further comprising an averaging-in-time unit for taking an average in time of output signals of the correction-value detecting unit, the averaging-in-time unit storing a plurality of signals outputted from the correction-value detecting unit in one correction-value detecting process thereby making an averaging process in time.

8. A radio communication apparatus according to claim 2, further comprising a user control unit for detecting a user greater in reception power out of output signals of the inter-array signal compositing unit, the user control unit making a user control such that correlation operation is carried out on a detected user by the first and second correlators.

9. A radio communication apparatus according to claim 3, further comprising a reception-power detecting unit for detecting powers of the signals received at the antenna elements of the array antenna, power information detected by the reception-power detecting unit is used to make a control such that a reception branch is selected by the first and second selector units.

10. A radio communication apparatus according to claim 9, wherein the first and second selector units are placed under control to preferentially select a reception branch having a greater reception power.

11. A radio communication apparatus according to claim 5, further comprising a mutual coupling correcting matrix memory unit for previously storing a correction matrix for correcting the array antenna for antenna mutual coupling, an inter-array signal compositing process being made to output reception data by using signals outputted from the plurality of radio circuit sections on the reception branches, reception-branch-based correction values stored in the correction-value memory unit, and the correction matrix stored in the mutual coupling correcting matrix memory unit.

12. A radio communication apparatus having an array antenna made up by a plurality of antenna element and an inter-array signal compositing unit for compositing signals received at the antenna elements together, the radio communication apparatus comprising:

- a first radio circuit section for conveying the signals received at the antenna elements to the inter-array signal compositing unit;

- a second radio circuit section for branching and conveying the received signals;

- a channel estimating unit for determining a channel

estimation value of a signal conveyed through the first radio circuit section;

a first operating unit for multiplying a conjugate complex number of the channel estimation value on a same path outputted from the channel estimating unit;

a second operating unit for multiplying a conjugate complex number of the channel estimation value for a reception branch on a same path as one taken a correlation with a known signal conveyed through the second radio circuit section; and

a correction-value detecting unit for detecting a correction value for correcting an amplitude deviation and phase deviation occurring in the first and second radio circuit sections, from outputs of the first and second operating units.

13. A radio communication apparatus according to claim 12, wherein the first radio circuit section, the second radio circuit section, and the first and second operating units are provided in plurality correspondingly to the antenna elements, and comprise a plurality of first correlators for separately detecting the signals conveyed through the plurality of first radio circuit sections as signals arrived at different timing and outputting the detected signals to the first channel estimating unit, a plurality of second correlators for separately detecting the

signals conveyed through the plurality of second radio circuit sections as signals arrived at different timing and outputting the detected signals to the second channel estimating unit, a first adder for adding outputs of the plurality of first operating units together, a second adder for adding outputs of the plurality of second operating units together, and third and fourth correlators for taking correlations with known signals on output signals of the first and second adders, the correction-value detecting unit comparing between an output of the third correlator and an output of the fourth correlator thereby detecting an amplitude variation and phase variation over the reception branch.

14. A radio communication apparatus comprising:

an array antenna having a plurality of antenna elements;

a first radio circuit section for conveying signals received at the antenna elements to an inter-array signal compositing unit;

a first selector unit for selecting any of signals conveyed through the first radio communication section;

a second selector unit for selecting any of the signals received at the array antenna;

a second radio circuit section for conveying a signal selected by the second selector unit;

a correction-value detecting unit for detecting an amplitude deviation and phase deviation occurring at the first radio circuit section, by using a signal selected by the first selector unit and a signal conveyed through the second circuit section;

a plurality of first correlators for detecting separately a plurality of paths different in propagation delay time from the signal conveyed through the first circuit section;

a plurality of first channel estimating units for determining channel estimation values of the respective paths detected by the first correlators;

a plurality of second correlators for detecting separately a plurality of paths same as the first correlators from the signals conveyed through the second radio circuit section;

a plurality of second channel estimating units for determining channel estimation values of the respective paths detected by the second correlators;

a plurality of power detecting units for detecting path-based powers from outputs of the first channel estimating units;

a plurality of multiplying unit for multiplying a conjugate complex number of the output of the first channel estimating unit on a same path as the output of the second



channel estimating unit;

a first adder for adding outputs of the plurality of power detecting units together; and

a second adder for adding outputs of the plurality of multiplying units together.

15. A radio communication apparatus according to claim 14, further comprising a selector control unit for controlling a signal selected by the first and second selector units, the selector control unit being placed under control to select a signal outputted from the first selector unit and a signal outputted from the second selector unit that are signals received at the same antenna element.

16. A radio communication apparatus according to claim 15, wherein the selector control unit is placed under control to select signals in one of a predetermined order, a desired order, a predetermined time interval and a desired time interval.

17. A radio communication apparatus according to claim 14, further comprising a correction-value memory unit for separately storing correction values outputted from the correction-value detecting unit, based on an antenna element selected by the first and second selector units, inter-array signal compositing process being made by using antenna-element-based correction value stored in the correction-value memory unit.

18. A radio communication apparatus according to claim 14, further comprising a first averaging-in-time unit for taking an average in time of output signals of one of the power detecting unit and the first adder, and a second averaging-in-time unit for taking an average in time of output signals of one of the multiplying unit and the second adder, and the first and second averaging-in-time unit take an average of a plurality of signals outputted from the first and second adders in one process.

19. A radio communication apparatus according to claim 14, further comprising an averaging-in-time unit for taking an average in time of output signals of the correction-value detecting unit, and the first and second averaging-in-time unit take an average of a plurality of signals outputted from the correction-value detecting unit in one process.

20. A radio communication apparatus according to claim 14, further comprising a user control unit for detecting a user greater in reception power out of output signals of the inter-array signal compositing unit, the user control unit making a user control such that correlation operation is carried out on a detected user by the first and second correlators.

21. A radio communication apparatus according to claim 15, further comprising a reception-power detecting unit for detecting powers of the signals received at the antenna

elements of the array antenna, power information detected by the reception-power detecting unit being used to make a control to select a reception signal by the selector control unit.

22. A radio communication apparatus according to claim 21, wherein the selector control unit preferentially selects an antenna element conveying a signal having a greater reception power.

23. A radio communication apparatus according to claim 17, further comprising a mutual coupling correcting matrix memory unit for previously storing a correction matrix for correcting the array antenna for antenna mutual coupling, an inter-array signal compositing process being made by using signals outputted from the plurality of first radio circuit sections, reception-branch-based correction values stored in the correction-value memory unit, and the correction matrix stored in the mutual coupling correcting matrix memory unit.

24. A radio communication apparatus according to claim 14, having a plurality of process blocks each of which is configured by the plurality of first and second correlators, the plurality of first and second channel estimating units, the plurality of power detecting units, the plurality of operating units and the first and second adders, further comprising a first user compositing unit for compositing together outputs of the first adders in the process blocks

and a second user compositing unit for compositing together outputs of the second adders in the process blocks, the process blocks making a process on a user-by-user basis, the first and second user compositing units correcting a correction value by using a result of user composition.

25. A radio communication apparatus having an array antenna made up by a plurality of antenna elements and an inter-array signal compositing unit for compositing signals received at the antenna elements, the radio communication apparatus comprising:

reception branches;

a calibration branches provided separately from the reception branches; and

means for combining channel estimation values of both the reception branches and the calibration branch in RAKE composition by using a channel estimation value of the reception branch, a result of which is used to correct for an amplitude/phase deviation between the reception branches.

26. A radio communication apparatus according to claim 25, wherein the reception branches are configured by a plurality of reception branches to convey signals received at the plurality of antenna elements, the calibration branch being configured by selecting one of the reception branches.